# Annual Research Programme

## (2015-2016)

## Biotechnology Division

## PROGRAMME AREA I : BIOTECHNOLOGY

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| **Project 1.** | **:** | **Varietal improvement of different crops using biotechnological and other advanced approaches** |
| Objectives | **:** | Development of<br>- Biotic and abiotic stresses<br>- high yield, premium and fine grain quality of rice with aroma<br>- Biofortified crop varieties<br>- morpho-molecular characterization of crop varieties |
| Personnel assigneded | **:** | Dr. M. M. Islam, PSO (PI) and Head<br>Dr. S. N. Begum, SSO<br>Mr. Mohammad Ferdous Ikbal, SO<br>Mrs. Sultana Razia, SO<br>Mr. Md. Ashraful Islam, SO<br>Mr. Md. Abdur Rahman, SA-I<br>Mr. Md. Najmul Islam, SA-I<br>Mr. Md. Rashedul Haque, SA-II<br>Mrs. Israt Shaira, SA-II |
| Status | **:** | One Green Super Rice (Proposed Binadhan-17GSR) line was recommended by Technical Committee of National Seed Board for release. Molecular characterization of crop varieties/cultivars/ mutants have been done using SSR and RAPD markers. |

**Experimental details**

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| **Experiment 1.** | **:** | **Growing of $M_1$ generation of rice (BRRI dhan28)** |
| Objective(s) | **:** | To develop high yielding and early maturing variety |
| Growing season | **:** | Aus, Aman and Boro |
| Design and replication | **:** | Plant progeny rows |
| Location | **:** | BINA HQ, Mymensingh |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |
| **Experiment 2.** | **:** | **Growing/Screening of $M_2$, $M_3$ and $M_4$ generation of different landraces and exotic rice germplasm using molecular markers** |
| Objective(s) | **:** | To select desirable mutants for drought and disease tolerance |
| Growing season | **:** | Aus, Aman and Boro |
| Design and replication | **:** | Plant progeny rows |
| Location | **:** | BINA HQ, Mymensingh |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |
| **Experiment 3.** | **:** | **Evaluation of $M_5$ generation of selected segregating plants of NERICA for drought tolerance using phenotypic and molecular markers** |
| Objective(s) | **:** | To select desirable mutants having drought tolerance, short duration, higher grain yield, fine and medium fine grain and resistance/ tolerance to major diseases/ insects. |
| Growing season | **:** | Aus, Aman and Boro |
| Design and replication | **:** | Plant progeny rows |
| No. of entries | | 99 lines |
| Location | **:** | BINA HQ, Mymensingh, Farmer's field: Chapainawabganj (Nachole) |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, biomass wt. drought scoring and genotypic data |

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| **Experiment 4.** | **:** | **Preliminary yield trial of some promising NERICA rice mutants for drought tolerance** |
| Objective(s) | **:** | To select desirable mutants having drought tolerance, short duration, higher grain yield, fine and medium fine grain and resistance/ tolerance to major diseases/ insects. |
| No. of lines | **:** | 11 lines + 4 checks (NERICA-1, NERICA-4 & NERICA-10 + BR26, BRRI dhan48, BRRI dhan56 & BRRI dhan28) |
| Growing season | **:** | Aus, Aman and Boro |
| Design and replication | **:** | RCBD with 3 replications |
| Location | **:** | BINA HQ,Mymensiongh, Farmer's field: Chapainawabganj (Nachole) |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |
| **Experiment 5.** | **:** | **Advanced yield trial of some promising NERICA rice mutants for drought tolerance** |
| Objective(s) | **:** | To select desirable mutants having drought tolerance, short duration, higher grain yield, fine and medium fine grain and resistance/ tolerance to major diseases/ insects. |
| No. of lines | **:** | 8{4 mutants ($N_4$/250/P-2(5)-11-2, $N_{10}$/300/P-2-3-5-1, $N_1$/250/P-6-2-6-1 & $N_1$/250/P-7-3-12-2-1) + 4 checks (NERICA-1, NERICA-4 & NERICA-10 + BRRI dhan48, BRRI dhan56 & BRRI dhan28)} |
| Growing season | **:** | Aus, Aman and Boro |
| Design and replication | **:** | RCBD with 3 replications |
| Location | **:** | BINA HQ, Mymensingh and BINA Sub-station: Chapai Nawabganj Farmer'sfield: Rajshahi (Godagari) and Chapai Nawabganj (Nachole) |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |
| **Experiment 6.** | **:** | **Zonal yield trial of promising dual tolerant rice lines for salinity and submergence prone areas** |
| Objective(s) | **:** | To select desirable lines for both salinity and submergence tolerance for salt and submerged affected areas |
| Growing season | **:** | Aman and Boro |
| No. of lines | **:** | 2 lines (B-10 & B-11) + 2 checks (Binadhan-11, Binadhan-10 and BRRI dhan41) |
| Design and replication | **:** | RCBD with 3 replications |
| Location | **:** | **Submergence prone area**: Dhobaura, Nalitabari and Roumari<br>**Salinity prone area** : Satkhira, Barisal and Patuakhali |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |
| **Experiment 7.** | **:** | **On-farm/ on station trial of promising NERICA Rice mutants** |
| Objective(s) | **:** | To evaluate yield potentiality and drought tolerance |
| Growing season | **:** | Aus and Aman |
| No. of lines | **:** | 2 lines ($N_4$/350/P-4(5) & $N_{10}$/350/P-5-4) + 2 checks (BRRI dhan48, BRRI dhan56) |
| Design and replication | **:** | RCBD with 3 replications |
| Location | **:** | BINA,HQ and BINA Sub-station: Chapainawabganj, Nalitabari, Rangpur and Comilla<br>Farmer's field: Rajshahi (Godagari & Tanore) and Chapai Nawabganj (Sadar & Nachole) |

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| Unit plot size | : | 6m × 5m |
| Data to be recorded | : | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |

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| **Experiment 8.** | : | **Evaluation of NERICA mutants and some selected varieties in aus and aman season for drought tolerance** |
| Objective(s) | : | To select desirable mutants having drought tolerance, short duration, higher grain yield, fine and medium fine grain and resistance/ tolerance to major diseases/ insects. |
| Growing season | : | Aman |
| Varieties/mutants/lines | | 4 NERICA mutants lines+ 1 GSR + 3 varieties (Binadhan-7, Binadhan-11, Binadhan-14) + 1 check (BRRI dhan56) |
| Design and replication | : | RCBD with 3 replications |
| Location | : | BINA HQ, BINA Sub-station: Chapai nawabganj, Ishurdi, Magura and Rangpur.<br>Farmer's field: Rajshahi (Godagari & Tanore) and Chapai Nawabganj (Sadar & Nachole) |
| Data to be recorded | : | Days to flowering, days to maturity, plant height, Panicle length, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant. |

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| **Experiment 9.** | : | **Marker-assisted backcrossing ($BC_2F_3$ of Binadhan-7×FL-478) for development of salt tolerant rice variety** |
| Objective(s) | : | To introgress salt tolerant genes |
| Growing season | : | Aman and Boro |
| Location | : | Glasshouse, BINA HQ |
| Data to be recorded | : | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, SES scoring and genotypic data |

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| **Experiment 10.** | : | **Evaluation of selected salt tolerant rice lines with better grain quality in multi-location trials (STRASA Project)** |
| Objective(s) | : | To identify salt tolerant rice lines in PVS locations |
| Growing season | : | Aman and Boro |
| Varieties/mutants/lines | : | 6 lines + 2 checks (BRRIdhan54 and Binadhan-10 ) |
| Design and replication | : | RCBD with 3 replications |
| Location | : | Satkhira sadar, Kaligonj, Shyamnagar and Dumuria, Khulna |
| Total trials | : | 4 mother trials + 3 baby trials |
| Data to be recorded | : | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, fertility (%),1000 seed wt., biomass wt., grain yield/plot and salinity level (Soil and Water). |

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| **Experiment 11.** | : | **Evaluation of promising submergence tolerant rice germplasm in multi location trials (STRASA Project)** |
| Objective(s) | : | To identify submergence tolerant rice lines through PVS |
| Growing season | : | Aman |
| Mutants/lines | : | 4 lines + 2 checks (Binadhan-11 and Binadhan-12) |
| Design and replication | : | RCBD with 3 replications |
| Total trials | : | 4 mother trials + 3 baby trials |
| Location | : | 3 (Dhobaura, Nalitabari and Nokla upazila of Sherpur) |
| Data to be recorded | : | Survivality (%),days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., biomass wt. and grain yield/plot |

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| **Experiment 12.** | **:** | **Screening, purification and morpho-molecular characterization of coastal rice landraces for salt tolerance.** |
| Objective(s) | **:** | To identify salt tolerant rice lines from landraces |
| Growing season | **:** | Aman and Boro |
| Varieties/mutants/lines | **:** | 15 lines |
| Location | **:** | Satkhira Sadar, Kaliganj, Shyamnagar and Paikgacha (Khulna) |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, biomass wt.,SES scoring and genotypic data |
| **Experiment 13.** | **:** | **Screening of both salinity and Zn deficiency tolerance elite breeding rice lines (STRASA Project)** |
| Objective(s) | **:** | To select desirable rice lines for Zn deficiency and salt tolerance |
| Growing season | **:** | Aman and Boro |
| Varieties/mutants/lines | **:** | 6 lines + 2 checks (Binadhan-8 and Binadhan-10 ) |
| Design and replication | **:** | RCBD with 3 replications |
| Location | **:** | Satkhira sadar, Kaligonj, Shyamnagar, Chokoria and Bashkhali |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, biomass wt., SES scoring, salinity level (soil and water) and genotypic data |
| **Experiment 14.** | **:** | **Association mapping for salinity and drought tolerance in rice genotypes** |
| Objective(s) | **:** | To develop breeding lines for salinity and drought, also to find out additional QTLs for salinity and drought tolerance |
| Varieties/mutants/lines | **:** | 60 lines |
| Growing season | **:** | Aman and Boro |
| Location | **:** | BINA HQ, Mymensingh, Rajshahi, Chapainawabgonj and Satkhira |
| Data to be recorded | **:** | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, biomass wt., SES scoring, salinity level (soil and water) and genotypic data |
| **Experiment 15.** | **:** | **Introgression of drought tolerant gene into Bangladeshi popular rice varieties through induced mutation and marker assisted selection** |
| Objective(s) | **:** | Introgression of drought tolerant gene into Binadhan-11, Binadhan-16, Binadhan-17 using induced mutation and marker assisted selection |
| Varieties/mutants/lines | **:** | 3 lines |
| Growing season | **:** | Aman and Boro |
| Location | **:** | BINA HQ, Mymensingh. |
| Data to be recorded | | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, biomass wt. and genotypic data |
| **Experiment 16.** | **:** | **Iron Biofortification of rice** |
| Objective(s) | **:** | To develope Fe- rich rice variety |
| Varieties/mutants/lines | **:** | 300 lines |
| Growing season | **:** | Aman and Boro |
| Location | **:** | BINA HQ, Mymensingh. |
| Data to be recorded | **:** | Yield and yield contributing character |
| **Experiment 17.** | **:** | **Introgression of salinity and submergence tolerant genes into leading rice varieties** |
| Objective(s) | **:** | To introgress saltol-Sub1 genes from selected IRRI lines into Binadhan-10 and Binadhan-11 |

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| Varieties/mutants/lines | : | 8 lines |
| Growing season | : | Aman and Boro |
| Location | : | BINA HQ, Mymensingh. |
| Data to be recorded | : | Days to flowering, days to maturity, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, biomass wt. and genotypic data |

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| **Experiment 18.** | : | **Screening of advanced mutants/ exotic lines for development of Zn enriched rice variety** |
| Objective(s) | : | To develope Zn enriched rice variety for enhancing nutritional balance for human health |
| Varieties/mutants/lines | : | 300 mutants/ exotic lines |
| Growing season | : | Aman 2015 |
| Location | : | BINA HQ, Mymensingh |
| Data to be recorded | : | Zn, Iron yield and yield component |

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| **Project 2** | : | **Morpho-molecular characterization of crop varieties/ germplasm** |
| Objectives | : | To characterize crop varieties/germplasm |
| Personnel assigned | : | Dr. Shamsun Nahar Begum, SSO (PI)<br>Dr. Mirza Mofazzal Islam, PSO<br>Mr. Mohammad Ferdous Ikbal, SO<br>Mrs. Sultana Razia, SO<br>Mr. Md. Ashraful Islam, SO<br>Mr. Md. Abdur Rahman, SA-I<br>Mr. Md. Najmul Islam, SA-I<br>Mr. Md. Rashedul haque, SA-II<br>Mrs. Israt Shaira, SA-II |
| Status | : | On going |

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| **Experiment 19.** | : | **DNA fingerprinting and molecular characterization of varieties/mutants via molecular markers** |
| Objective(s) | : | To characterize varieties/mutants at molecular level |
| Growing season | : | Round the year |
| Varieties/mutants/lines | : | BINA released varieties and advanced mutants/germplasm of crops |
| Location | : | Biotech Lab, BINA HQ |
| Data to be recorded | : | Yield and yield components, allele size, allele frequency, PIC, genetic distance, dendrogram etc. |

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| **Project 3** | | **Developement of Diseases Resistant Crop Variety** |
| **Experiment 20.** | : | **Marker assissted pyramiding of Bacterial blight resistant genes in popular Binadhan-10 rice ( BMGF Project-biotic stress)** |
| Objective(s) | : | To develope bacterial blight resistance lines of Binadhan-10 |
| Growing season | : | Aman and Boro |
| Varieties/mutants/lines | : | IRBB60(NIL) + Binadhan-10 |
| Location | : | BINA HQ, Mymensingh |
| Data to be recorded | : | Disease resistance, yield and yield component |

**PROGRAM AREA II : Genetic Engineering**

**Project 1:** **Development of salinity/drought tolerant rice varieties**
**Objectives:** -To isolate salinity and drought induced novel genes of rice
-To develop salinity and drought tolerant transgenic varieties of rice

**Personnel assigned:** Dr. Md. Imtiaz Uddin, SSO (PI)
Dr. Mirza Mofazzal Islam, PSO
Dr. Md. Harun-or Rashid, SSO (Soil Sci. Div.)
Mr. Mohammad Ferdous Ikbal, SO
Mrs. Sultana Razia, SO
Mr. Md. Ashraful Islam, SO

**Status:** New

Salinity and drought are the two major environmental factors that impact plant growth and productivity. Almost all aspects of plant activities are affected by salinity and drought stresses, directly or indirectly. This time gene technology has opened the opportunity to isolate stress induced genes and subsequently to develop tolerant varieties. **Pokkali** is a well known salinity tolerant cultivar which induces two novel salt tolerant genes *OsNHX* ($Na^+/H^+$ vacuolar antiporter) and *OsHKT* (responsible for $Na^+$ homeostasis). Recently, we identified two novel genes *OsARP* (*Oryza sativa* antiporter regulating protein) and *OsMGD* (*Oryza sativa* monogalactosyldiacylglycerol synthase) (Lab of Plant Biotechnology, Tottori University, JAPAN) from a submergence tolerant local cultivar **FR13A** and showed high level of tolerance to salinity and drought by overexpressing in tobacco plants. Here we will take initiation to isolate novel salinity/drought tolerant genes and then transfer these genes into rice through genetic transformation.

**Experimental details:**

**Experiment 1. Expression and detection of salinity and drought induced genes through RT-PCR (Reverse transcriptase polymerase chain reaction)**

Objective : To identify salinity and drought induced novel genes of rice
Growing season : Round the year
No. of lines/genotypes: 2 (Pokkali and FR13A)
Design/replications : -
Unit plot size : -
Location : Biotech/Tissue culture lab, BINA HQ
Data to be recorded : Total RNA, mRNA and RT-PCR.

**Experiment 2.** **Cloning of salinity and drought induced rice genes through Gateway technology**
Objective : To construct the clones of salinity and drought induced novel genes of rice
Growing season: Round the year
No. of lines/genotypes: 4 genes (*OsNHX* and *OsHKT* from Pokkali; and *OsARP* and *OsMGD* from FR13A)

Design/replications : -
Unit plot size : -
Location : Biotech/Tissue culture lab, BINA HQ
Data to be recorded : Transformation efficiency, PCR, restriction enzymes digestions and DNA sequencing.

**Experiment 3. Transfer of salinity and drought tolerant genes into rice through *Agrobacterium* mediated gene transformation**

Objective : To develop salinity and drought tolerant transgenic rice varieties
Growing season : Round the year
No. of lines/genotypes: 4 genes (Abscisic stress, Calmodulin like protein1, ranBP1 domain containing protein and MR219 Hypothetical protein); 2 rice varieties (Binadhan-7, BRRI dhan-28)
Design/replications : -
Unit plot size : -
Location : Biotech/Tissue culture lab, BINA HQ
Data to be recorded : Regeneration ability, transformation efficiency, genomic PCR, RT-PCR, morpho-physiological parameters related to salinity and drought stress.

**Project: Development of early maturing high yielding rice varieties**

**Objective**s :1) To isolate early maturing high yielding induced novel genes of rice
2) To develop early maturing high yielding transgenic varieties of rice

**Personnel Assigned :** Dr. Sakina Khanam, SSO (PI)
Dr. Mirza Mofazzal Islam, PSO
Mr. Mohammad Ferdous Ikbal, SO
Mrs. Sultana Razia, SO
Mr. Md. Ashraful Islam, SO

**Status:** New

Aman rice followed by Boro rice is a popular cropping pattern. The time between Aman rice harvest in December and Boro rice transplanting in February is not sufficient to grow a crop and therefore the land remains unused for two months. Replacing traditional Aman rice varieties with varieties which mature 30 days earlier without significant yield loss would allow farmers to grow a short season crop such as oil seed mustard between the Aman and Boro rice crops. Molecular techniques have created opportunity to isolate heading gene and subsequently develop varieties of interest. Binadhan-7, Binadhan-14 and Binadhan-16 are early maturing and high yielding varieties. Flowering and heading gene can identify and observe the overexpression in tobacco plant. Then will take initiative to isolate genes and then transfer these genes into high yielding but later maturing rice or other economically important crops through genetic transformation.

**Experimental details:**

**Experiment 1 : Detection and expression of early maturing and high yielding induced gene**

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| Objectives | : To isolate early maturing high yielding induced novel genes of rice |
| Growing season | : Round the year |
| No. of varieties/lines | : Binadhan-7, Binadhan-14, Binadhan-16, BRRIDhan 56, BRRIDhan-57, BRRIDhan 62, BRRI hybrid Dhan 4 and some promising mutant from BINA |
| Unit plot size | : |
| Location | : Biotechnology/tissue culture lab, BINA, HQ |
| Data to be recorded | : DNA, RNA, cDNA, RT-PCR, Gene Blot |

**Experiment 2 : Cloning of early maturing and high yielding induced gene**

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| Objectives | : To isolate early maturing high yielding induced novel genes of rice |
| Growing season | : Round the year |
| No. of varieties/lines | : Expressed genes related to early maturing and high yielding characteristics |
| Unit plot size | : |
| Location | : Biotechnology/tissue culture lab, BINA, HQ |
| Data to be recorded | : Plasmid isolation, Transformation efficiency, PCR, Restriction enzymes digestions and DNA sequencing. |

**Experiment 3 : Transfer of early maturing and high yielding induced gene through *Agrobacterium* mediated gene transformation**

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| Objectives | : To develop early maturing high yielding induced transgenic rice varieties |
| Growing season | : Round the year |
| No. of varieties/lines | : Expressed genes related to early maturing and high yielding characteristics |
| Unit plot size | : |
| Location | : Biotechnology/tissue culture lab, BINA, HQ |
| Data to be recorded | : Regeneration ability, transformation efficiency, genomic PCR, RT-PCR, morpho-physiological parameters related to early maturing high yielding characteristics |

**Personnel Assigned:** Dr. Md. Babul Akter, SO (PI)
Dr. Mirza Mofazzal Islam, PSO
Mr. Mohammad Ferdous Ikbal, SO
Mrs. Sultana Razia, SO
Mr. Md. Ashraful Islam, SO

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| **Experiment 1.** | **:** | **Genetic analysis and identification of a regulatory gene for semi-dwarf rice** |
| Objective(s) | **:** | To locate, identify and isolate the semi-dwarf gene in rice |
| No. of lines/genotypes**:** | **:** | 2 (1 mutant and1 mother) |
| Growing season | **:** | Round the year |
| Design/replications | **:** | |
| Unit plot size | **:** | |
| Location | **:** | Biotech Lab, BINA HQ |
| Data to be recorded | **:** | Days to flowering, plant height, no. of effective tillers/hill, no. of filled and unfilled grains/plant, 1000 seed wt., grain yield/plant, internodes elongation pattern, panicle length, seed shape and size, cell structure, hormonal effect, root structure etc. |

**Head of Biotechnology Division** **CSO (RC)** **Director (Research**